# ARTIFICIAL CREATIVITY:

## Musically Improvising Computers and the Listening Subject

By Jessica Shand

*The truly creative mind in any field is no more than this:*
*a human creature born abnormally, inhumanly sensitive.*
*By some strange, unknown, inward urgency he is not really alive*
*unless he is creating.*

– Pearl S. Buck, Nobel Laureate in Literature (1938)

**Introduction**

The etymology and ever-changing usage of 'creativity' can be traced back to Chaucer, whose fourteenth-century *Canterbury Tales*, which mentions 'creativity' as an allusion to divine creation, marks the word's first appearance in written English.[1] Since Chaucer, a number of Western reformulations of creativity have emerged, largely eluding its origins within the biblical context. Among these reformulations, it is the Romantic one – a conception of creativity as the artistic expression of the genius, innate and mysterious, and the mark of access to a dimension beyond the mundane[2] – which persists.

To gain some distance from the concept of creativity, it is worth taking a moment to observe its embeddedness in a complex web of cultural, economic, and social values. Note, for example, the use of the masculine 'he' in the epigraph that precedes this introduction. What assumptions might we subconsciously carry about who or what can be considered innovative? How might this quotation have been rewritten just thirty years later, in the midst of second-wave feminism in the United States? Creativity seems to have a history, rather than being the signifier for a universal signified – and more than a history, it has a *geography*. While Western frameworks of creativity emphasize individuality, novelty, and difference, often using gendered language to do so, in Eastern contexts the creative act has traditionally been understood as a process of "uncovering an essence through an exploration of or meditation on a long-standing theme."[3] It is a rediscovery, an 'invention' from the Latin *invenire* (to encounter, to find), more than it is a newness.

In the twenty-first century, the development of sophisticated artificial intelligence (AI) techniques has only further transformed the notion of creativity. From self-driving cars to chatbots to computer programs that compose in the style of Mozart and Bach, AI has forced us to reconsider human relationships with not only technology but also with art, consciousness, and indeed, creativity. What becomes of creativity when machines begin to deliver original solutions to problems or even develop a sense of aesthetic taste? The visionary nineteenth-century mathematician Ada Lovelace once remarked that "only when computers originate things should they be believed to have minds,"[4] and it seems that we have far surpassed that point. However, Lovelace also insisted that since machines cannot operate beyond the bounds of what human programmers make them to do, they cannot be construed as creative – even if they are, in fact, originating things.[5]

In this paper, I do not attempt to define an absolute idea of creativity; rather, I turn toward musically improvising computers to unpack notions of creativity within a very specific context (namely, 21st-

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[1] Runco, Mark A. and Robert S. Albert. "Creativity Research." *The Cambridge Handbook of Creativity* (2010): Cambridge University Press.
[2] Samson, Jim. "Romanticism," *Grove Music Online. Oxford Music Online.* Oxford University Press, accessed December 8, 2019, http://www.oxfordmusiconline.com/subscriber/romanticism/grove/.
[3] Westwood, Robert and David R. Low. "The Multicultural Muse: Culture, Creativity and Innovation." *International Journal of Cross-Cultural Management* 3 (2003): 239.
[4] Oppy, Graham and David Dowe. "The Turing Test". *The Stanford Encyclopedia of Philosophy* (2019). https://plato.stanford.edu/archives/spr2019/entries/turing-test/.
[5] Oppy, Graham and David Dowe. "The Turing Test".

century contemporary art music) using American composer Pauline Oliveros's Expanded Instrument System (EIS) as a case study. I allow for a creativity that is co-determined by a non-human, machinic agency, temporarily setting aside Lovelace's famous assumption that machines cannot be creative. In order to do this, I rely on the method of actor-network theory (ANT), which examines both human and non-human actors in terms of the natural and social networks of relations in which they exist and thereby assigns agency to all such actors. Through a close reading of the role of computer-improvisers in the music of Pauline Oliveros as performed by her close friend and collaborator, the flutist Claire Chase, I ask: how is creativity constructed in Oliveros's context? How has software and hardware shaped and been shaped by that construction? As in this case study the notion of creativity is strictly tied to that of improvisation, I also question the relationship between the two. To conclude, I directly respond to recent developments in the theorization of the listening subject as put forth by musicologist Nina Eidsheim – namely, her proposal for a vibrational practice of listening in which "music is predominantly understood…as material and intermaterial vibration."[6] I argue that Eidsheim's model breaks down in the face of computer temporalities that operate outside of, even beyond, the material here-and-now: indeed, any contemporary practice of listening must be pliable enough to capture the agency, however immaterial, of the listening machine.

**(Re)-Theorizing Creativity: Object as Agent**

Music research has historically naturalized subject-object dualism by assuming a proprietorial model for agency.[7] That is, until recently, musical agency has generally been depicted as something that one immutably "has" or does not "have," whereby subjects act and objects are acted upon. However, as Benjamin Piekut has argued, there is much – perhaps more – to be gained from a methodology that considers the network or "motile web of relations" that produces and transforms subjects and objects in the first place.[8] How are differences produced within a network, intentionally or not? How do events, actions, and interactions determine an actor and vice-versa? This is precisely the framework offered by actor-network theory (ANT).

As Piekut writes, "for ANT, an actor need not realize, understand, or intend the difference it makes, but it nonetheless should be accounted for in the analysis."[9] As such, ANT removes the presumption of sentience at the core of the conventional agential subject. Per the ANT method, note that I define agency here as *the ability to effect change within a network*: at a very minimum, it is clear that the creative act effects change within the actor responsible for it. In a musical context, this allows us to examine the materiality and assemblages of whatever is called 'music' at a given time, removing any *a priori* idea of what constitutes music. We can then proceed to examine the movement, influence, and transformation of sounds, ideas, technologies, and institutions – all of which turn out to be integral mediators of musical networks.

For an example, consider listening technologies such as groove trackers that attempt to bring the nonlinear phenomenon of human hearing to binary code.[10] Groove trackers are designed to "feel" the signature beat of a song, performing an automated version of the cognitive skill that allows human listeners to detect and then synchronize with a beat (also known as beat induction). Importantly, while beat induction is believed to be a universal skill, it exhibits remarkable plasticity across contexts: metric entrainment is shaped by various factors including culture and (dis)-ability.[11] Nonetheless, groove trackers implement algorithms that detect and extract these psychologically perceived aspects of tempo and rhythm *by modeling a very specific kind of listener,* situated within a Western context. This makes things

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[6] Eidsheim, Nina Sun. "Music as a Vibrational Practice: Singing and Listening as Everything and Nothing." In *Sensing Sound: Singing and Listening as Vibrational Practice.* Duke University Press (2015): 161.
[7] Piekut, Benjamin. "Actor-Networks in Music History: Clarifications and Critiques." In *Twentieth-Century Music.* Cambridge University Press (2014): 194.
[8] Piekut, Benjamin. "Actor-Networks," 194.
[9] Piekut, Benjamin. "Actor-Networks," 196.
[10] Scherzinger, Martin. "Algorithms of Musical Time (from Biopower to Neuropower)." Keynote Lecture, ORCiM Seminar at the Orpheus Institute. Ghent, Belgium. February 25, 2015.
[11] Scherzinger, Martin. "Algorithms of Musical Time."

go awry when, as music theorist Martin Scherzinger has said, we venture into the nebulous realm of world music – for which, in many practices, the very aim of the music seems to be to *rotate* the beat![12] As a consequence, "what is experienced as interactive is in fact interpolative," and "pre-defined presentation semantics [that] are never seen by the user" create a "socio-technical feedback loop"[13] that shapes the way we perceive sound. Taking all of this into consideration, it seems that groove trackers are nothing if not agents in the construction of human ontologies of listening.

Standing on the shoulders of Piekut, Scherzinger, and a handful of other giants in the field,[14] I contend that inanimate objects ranging from instruments to headphones to sound systems play an inevitable role in shaping the human experience of music, a role that has received widespread attention in STS and media studies yet is still under-theorized in music. Moreover, as it is only with agency that creativity becomes possible regardless of context, we now have the tools to investigate the central question: how does the agential machine shape constructions of creativity in 21st-century contemporary art music and vice-versa?

**Pauline Oliveros, Claire Chase, & the EIS**

Among her innumerable contributions to the American postwar avant-garde, composer-performer Pauline Oliveros (1932-2016) is perhaps best known for coining the term *deep listening*, a practice of continually expanding one's sonic awareness across space and time.[15] Having been fascinated with resonant spaces for as long as she could remember, in the late 1950s Oliveros developed the desire to design, control, and interact with sophisticated sonic environments – at a time when stereo was still a novelty. "As my experience of numerous performance spaces accumulated," she wrote, "I began to wish for the possibility of changing the acoustic space while performing."[16] Especially with the advent of signal processors, it became temptingly possible to "tamper with the container of music in imaginative ways. The walls of a virtual acoustic space created electronically could expand or contract, assuming new angles or virtual surfaces."[17]

The earliest configuration of Oliveros's Expanded Instrument System (EIS) was an amalgamation of PCM42 digital delay processors, mics, and amplifiers manipulated through matrices and mixers.[18] A virtuoso accordionist, Oliveros performed with as many as four processors per hand in the EIS's early days. The technology could not keep pace with her imagination. In an interview in 2009, she would remark, "I'm not a technologist, I never pretended to be one, but I'm *using* it…I think about what hardware and software can do, then try to push it beyond what it is supposed to do."[19] Beginning with vocalist-composer Panaotis, Oliveros recruited a whole cohort of software engineers and musicians who helped transition the EIS toward foot pedals and then digital interfaces for control of the PCM42s, then to be able to accommodate an ensemble of performers, first using a centralized computer and then distributing control across all performers. As of 1993, each performer had "exclusive control over their sound processing until it emerged from the speakers into the performance space."[20]

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Figure 1: Lexicon PCM42 digital delay processor (https://www.vintagedigital.com.au/lexicon-pcm-42-digital-delay-processor/).

[12] Scherzinger, Martin. "Algorithms of Musical Time."
[13] Scherzinger, Martin. "Algorithms of Musical Time."
[14] See Jonathan Sterne.
[15] Oliveros, Pauline. *Deep Listening: A Composer's Sound Practice.* iUniverse (2005): xxiii.
[16] Oliveros, Pauline. "Acoustic and Virtual Space as a Dynamic Element of Music." *Leonardo Music Journal*, 1995.
[17] Oliveros, Pauline. "Acoustic and Virtual Space," 19.
[18] Oliveros, Pauline. "Acoustic and Virtual Space," 20.
[19] Arcangel, Cory. *Pauline Oliveros.* BOMB Magazine, April 1, 2009.
[20] Oliveros, Pauline. "Acoustic and Virtual Space," 22.

Built to be transparent and user-friendly, the EIS was readily adopted as a tool for artistic inspiration in the 90s, although through the 2000s its function was still largely determined by the sonic and manual input of human performers. As composer Kurt Erickson wrote, the interface "adapted existing sound processing technology to enable even non-technologically oriented musicians and composers to discover many new creative expressive possibilities unanticipated by the authors."[21] EIS has since become available as a stand-alone application or as a patch for MAX/MSP. Its list of modules has included a performance clock, master volume control, control mapping interface, matrix mixer, looper, reverb, and delays.[22]

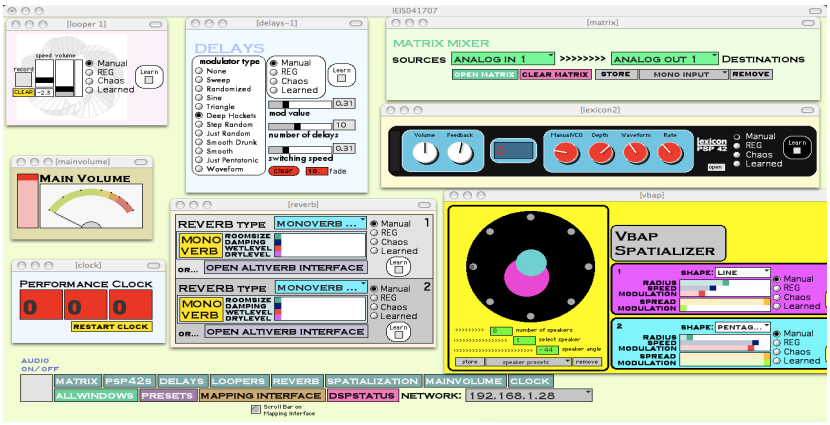


Figure 2: A selected configuration of EIS modules (reproduced from *The Expanded Instrument System: Recent Developments*).

Fast forward to 2015, when Claire Chase – who met Oliveros as a child, which would lead to a lifelong friendship – asked the composer to contribute a piece to the third installation of Density 2036, a 23-year commissioning project focused on building a new repertory for solo flute.[23] Of the pair's many collaborations, the resulting work, entitled *Intensity 20.15: Grace Chase* for Chase and EIS, stands out not only for its use of poetry written by Chase's late grandmother, but also for the sheer range of expression for which it calls, from meditation to ecstasy to near lunacy. After the premiere performance in October 2015, a *New York Times* reporter called the piece a "protracted sound tantrum" in which Chase "unleashed her virtuosity in intricate vocalizations and gleeful explosions of noise, electronically distorted, which she drew from all manner of instruments, objects and body parts – even the knees of a front-row listener."[24] Within two years of that performance, Chase had been named a Harvard professor; another two years later, in November 2019, I had the chance to sit down and speak with Chase directly about her experiences with the EIS.

[21] Oliveros, Pauline and David Gamper. "The Expanded Instrument System: Recent Developments." Pauline Oliveros Foundation. 7.
[22] Oliveros, Pauline and David Gamper. "The Expanded," 2-3.
[23] For more, see http://www.clairechase.net/densityoverview.
[24] Fonseca-Wollheim, Corinna da. "Review: Claire Chase Explores the Flute's Possibilities." The New York Times, October 4, 2015.

Figure 3: Chase playing contrabass flute with the EIS at the premiere of *Intensity 20.15* (https://vimeo.com/144688633).

The published program note for *Intensity 20.15* addresses the EIS in a rather down-to-earth, if scientific, way. In this version of the software, Oliveros writes, all sounds originate from the human performer, are picked up by a headset microphone, and are then processed through a series of modules that output to a multichannel sound array. In private, however, Chase says that Oliveros spoke of the EIS in characteristically futuristic, bright-eyed language. According to Chase, Oliveros described her own experiences performing with the EIS as "'improvising with an evolved version of a human,' evolved by centuries...with a more evolved virtuosity. But it wasn't just about virtuosity, it was about sensitivity, about the ability to listen, retain information, develop it, embellish it, and then bring it back to what it was, unadorned."[25]

In fact, it was largely due to the EIS's sensitivity that, during our conversation, Chase did not and seemingly could not speak of the EIS as an 'it.' "It feels weird to call it a thing," she said, laughing, "because it feels like a live being. The more extended my experiences with it became – I mean, I spent hours on end with it – the stranger and more wondrous the mind-meld with the machine."[26] For Chase, the EIS emerged as an actor whose artificial sentience was at times indistinguishable from her own. Moreover, it necessarily co-determined the creative possibilities of any collaboration. As the EIS generated new sounds, it pushed Chase, who says she thinks of creativity and imagination as "going beyond what we know," to do the same. "I was doing things on the flute that I didn't have names for," she remarked. "It really activated my creativity, and it was not just about making sound. It was also about listening to sound."[27]

When I pressed Chase further about the role of creativity in her practice, she responded without hesitation: "creativity is the engine. It's the core. I look at a lot of my work as an artist in terms of decolonizing my training and all of the ways that I have actually shut down my creativity [since childhood]."[28] In comparison with Romantic understandings of creativity, Chase's is more grounded in a pre-symbolic, childlike curiosity; she sees the child, far from the archetypal Faustian genius, as the most sublime creative being. Indeed, while a creativity that "goes beyond what we know" requires effort and maturity, it is also indicative of a kind of receptiveness and openness to experience that children naturally seem to possess.

It does not come as a surprise, then, that Chase would revere the EIS's capacity for creativity to the extent that she does. The EIS's lack of long-term memory and self-awareness – and hence its lack of many of the social, political, intellectual, and emotional hurdles that past experience can bring to the present – make it a fundamentally childlike companion, however intelligent or advanced. Its lack of physiological sensation makes it unsusceptible to stage fright, so that it will always be just as sonically receptive in performance as in practice. This is not to overemphasize lack: ultimately, the EIS's only

[25] Claire Chase, interview by author, Cambridge, MA, November 26, 2019.
[26] Claire Chase, interview.
[27] Claire Chase, interview.
[28] Claire Chase, interview.

limitations are those introduced by its human programmers. Responding to human performers in real time, it makes use of algorithms and systems that, unbeknownst to it, precede it. Ultimately, while the EIS does what it is programmed to do (as in Lovelace's objection to machine creativity), by Chase's standards, the EIS is programmed *precisely to be creative*. And moreover, its creativity forces us to consider: who (or what?) is being left out of contemporary discourses about the listening subject, and what might we gain from taking them into account?

**Creativity, Improvisation, & Temporality: A Response to Nina Eidsheim**

Oliveros's vision for the EIS came at a time when she and her contemporaries had begun to see a deeply humanitarian value in musical interaction with a technological Other (and not just interaction, but *improvisation*). George Lewis, whose Voyager project famously used computer-improvisers that he calls 'creative machines,' has written that "to improvise is to encounter alternative points of view and to learn from the Other. Improvising with computers allows us a way to look inside these and other fundamental processes of interaction."[29] Oliveros herself said in an interview that "improvised music is a great model for community building and reconciling differences…people who listen together grow and expand together."[30]

At the same time, improvisation has become a proxy for musical creativity, which in this setting invokes the unknown. Even in a collective improvisation, performers often do not know where they will travel, only that they are traveling. Lewis has said that he has accordingly "made efforts to imbue interactive systems," particularly his creative machines, with values such as "relative autonomy, apparent subjectivity, and musical uniqueness rather than repeatability."[31] Is it not a paradox that the same thing that appears to build and to strengthen community also necessarily shatters the very past, the familiar upon which community is presumably built?

To the contrary, it is through creativity as it manifests in improvisation that these musical communities construct their identities – identities *made to be re-constructed* – as Oliveros, Chase, and Lewis all seem to conclude. In improvised musics "sound becomes identifiable, not with timbre alone, but with the expression of personality, the assertion of agency, the assumption of responsibility and an encounter with history, memory and identity."[32] Difference on the individual level exists within a larger community that is never absolute. It is fluid, amenable, and welcoming of new musical actors, from never-before-seen instruments to luminous visual displays to robots and machines. With this in mind, contemporary theorizations of listening will benefit from considering computers legitimate musical subjects and, I argue, gravely miss out by omitting them.

In *Sensing Sound: Singing and Listening as Vibrational Practice*, Nina Eidsheim writes at length about the material experience of sound in real time. Importantly, she claims that "while we can meaningfully understand much music within the symbolic order, music continues to influence us within the pre-symbolic domain."[33] Consequently, for Eidsheim the most comprehensive understanding of listening must consider music in terms of vibration. The vibrational motion of sound physically penetrates and circulates through and across bodies and masses; at the same time, it is co-determined by the media through which it passes. Investigations of listening then become examinations of how vibration operates and how it is perceived.

Despite its uncontestable merits, Eidsheim's formulation of the listening subject clearly breaks down in the face of the kind of computer improvisation introduced by the EIS and Voyager. What is the pre-symbolic for a machine that depends entirely upon abstraction – for which meaning cannot exist without the symbolic? Moreover, what is vibration to a machine that, inorganic and untactile, perceives

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[29] Lewis, George. "Why Do We Want Our Computers to Improvise?" *The Oxford Handbook of Algorithmic Music*. Oxford University Press (2018): 6.
[30] Arcangel, Cory. *Pauline Oliveros*. BOMB Magazine, April 1, 2009.
[31] Lewis, George. "Why Do We Want," 5.
[32] Lewis, George. "Too Many Notes: Complexity and Culture in Voyager." Leonardo Music Journal, 10 (2000): 37.
[33] Eidsheim, Nina Sun. "Music as a Vibrational Practice," 158.

sound only in terms of the discrete aural parameters its software detects? This is not to do away with Eidsheim's theorization, nor is it to minimize the highly sensitive nature of the computer-improvisers that exist today. Rather, I argue that even a machine with a tactile sense, and hence some capacity to *feel* sound, will necessarily be operating in a temporality outside of the here-and-now that Eidsheim invokes by talking about vibration. That is, computers are built upon the abstractions of their programmers. While their listening and sounding creativity crystallizes in the present and indeed is partly determined by the sonic inputs of a live performer, their behavior will always be partly determined by a past and unavoidably symbolic construction: their coding. Ultimately, Eidsheim's vibrational practice underemphasizes the overbearing presence of macro-scale forces in favor of the micro-socialities of the present moment. In the case of computer improvisers, these macro-scale forces constitute the machine's ability to encounter the unknown, to *be creative* – indeed, they constitute much of the subject itself.

**Conclusion**

Rather than asking what creativity *is*, this paper followed how the notion of creativity acts in the 21st-century contemporary art music of Pauline Oliveros. This case study is evidence of the necessity of distancing oneself from an idea of creativity that is strictly related to human agency, as well as the necessity of methodologies that allow us to closely examine non-human agency. This need becomes particularly pressing when, per George Lewis's insights, we realize that the notion of creativity is crucial to understanding a community and an identity. The invention, advancement, and inclusion of computer-improvisers as listening subjects alongside their human counterparts has a lot to offer in the way of living in our post-humanist world, and it is time music theory and musicology embrace them with open arms.

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